NATURAL RESOURCES CONSERVATION SERVICE

VIRGINIA CONSERVATION PRACTICE STANDARD

WELL DECOMMISSIONING

(No.)

Code 351

DEFINITION

The sealing and permanent closure of a water well that has been determined to have no further beneficial use or whose use has been permanently discontinued.

PURPOSES

This practice serves to:

- Prevent entry of vermin, debris, or other foreign substances into the well or well bore hole
- Eliminate the physical hazard of an open hole to people, animals, and farm machinery
- Prevent entry of contaminated surface water into well and migration of contaminants into unsaturated (vadose) zone or saturated zone
- Prevent the commingling of chemically or physically different groundwaters between separate water bearing zones

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to any drilled, dug, driven, bored, or otherwise constructed vertical water well of 4" diameter or larger and 250 feet deep or less, constructed to supply water from an underground source.

This practice does not apply to wells that were used for waste disposal or if evidence of contamination still exists. This practice does not apply to wells that contain contaminant levels that exceed state or federal water quality standards. Treatment of contamination source(s) is required before a well is decommissioned.

This practice applies to permanently abandoned wells where surface contaminants may flow into a well and contaminate or pollute the groundwater aquifer, where the well has a potential of being used for dumping contaminated debris, where undesired interaquifer flow may occur within the well and/or a safety hazard is created by the presence of the well. Irrigation and other wells which require a water permit, flowing artesian wells, known multiple-aquifer wells, or test wells constructed for geologic investigations are not covered by this standard.

CRITERIA

GENERAL CRITERIA APPLICABLE TO ALL PURPOSES

All work planned shall be in compliance with General Manual Title 450-GM, Part 405; Subpart A, "Compliance with Federal, State, and Local Laws and Regulations". In accordance with Virginia Private Well Regulations (VR 355-34-100), Sections 2.12 and 2.13 require a written construction permit be obtained from the Virginia Department of Health prior to filling and abandoning any private well.

Conservation practice standards are reviewed periodically, and updated if needed. To obtain the current version of this standard, contact the Natural Resources Conservation Service.

Data Collection

All available data for the well shall be collected and reviewed from as-built construction and maintenance records; i.e., well log, the materials schedule, length, and diameter of casing, total well depth, type of liners and screens, and related information. The existing conditions of the well shall be documented as shown in the "Plans and Specifications" section.

Well Preparation

The well shall be cleared of all pumping equipment, valves, pipelines, casing liners, debris and other foreign material.

Casing

The well casing should be removed if possible. Where the well casing cannot be removed, and an open annular space exists between the outside of the casing and the well bore, then the annular space must be sealed, using sealing materials described in this standard. Sealing materials can be directed into the annular space as grout. As an alternative, the casing may be ripped or perforated to ensure that sealing materials completely fill the casing and any annular space. Also see the "Surface Seal" part of this standard.

Disinfection

Before sealing, the well water shall be brought to a 100-PPM chlorine concentration or other solution specified by local or state requirements. A 100-PPM chlorine solution will require:

1 gal. 5% chlorine bleach per 500 gal. of water

1 pt. 5% chlorine bleach per 62 gal. of water

1.3 lbs. high-test calcium hypochlorite tablets per 1,000 gallons of water

Sealing Materials

All materials used for sealing any portion of the well shall have a hydraulic conductivity equivalent to or less than that of the lowest hydraulic conductivity of the geologic materials being sealed. Properties of sealing materials shall conform to characteristics listed in ASTM D5299, Part 6.3, Plugging Materials.

To determine the volume of materials needed per foot of depth or volume of water in the hole, use the following chart:

Hole Diameter Inches	Volume Needed	
	Gal/Ft	Cu.FT/FT
4	0.7	0.1
6	1.5	0.2
8	2.6	0.3
10	4.1	0.5
12	5.9	0.8
14	8.0	1.1
16	10.5	1.4
20	16.4	2.2
24	23.6	3.1
36	53.0	7.1
48	94.2	12.6

Bentonite

Commercially chipped or pelletized bentonite, which swells when wet, is commonly purchased in granular form with a particle size of 1/4 to 3/4 inch. Powdered bentonite is not recommended for dry placement in well sealing operations. A general rule of thumb is that approximately 8 gallons of water is needed for proper hydration per 50 lb. Bag of bentonite.

Neat Cement Or Grout

Neat cement is a mixture of one bag (94 pounds or 1 cubic foot) of Portland cement and approximately 6 gallons of water blended to a consistency that permits pumping. The mixture of one 94-pound bag of cement and six gallons of water yields a volume of 1.1 cubic foot.

Native Clay

Native clay is defined as any material of local origin found below the topsoil that has a medium or loamy texture (excluding sandy loam), according to USDA Textural Classification System, or is classified a Silty Clay (CL-ML) or Lean Clay (CL) in the Unified Soil Classification System. Fat Clay (CH) material is not acceptable.

Fill Materials

In compliance with Virginia Private Well Regulations (VR 355-34-100), Sections 2.12 and 2.13, fill materials, such as sand, pea gravel, sand-gravel mix, crushed stone, or agricultural lime can be used to plug the well provided that zones of sealing materials (conforming to ASTM D5299, Part 6.3) are placed no less than one foot thick each at intervals no greater than 10 feet within the column. Fill materials shall be clean and free of organic or other foreign matter. The gradation shall be such that bridging will not occur during placement. This material should only be used on Type III wells. (See Figure 3)

Placement Of Materials

All materials shall be placed without bridging. For wells greater than 30 inches in diameter, backfill shall be placed in a manner that minimizes segregation and bulking in order to prevent surface subsidence.

Sealing

The entire well depth shall be filled with sealing materials as described below.

Bored wells shall be completely filled with bentonite, neat cement or native clay compacted in place. The following methods of sealing will be used; dependent upon whether the well is located in unconsolidated soil formations or rock:

Type I: Bored Wells and Uncased Wells (See Figure 1)

After sanitizing, the well shall be filled with chipped or pelletized bentonite, neat cement or clay to a point five feet below the ground surface as follows:
If bentonite is used, the bentonite should be added slowly at a rate of about one bag per 3 minutes to prevent bridging. The bentonite should be saturated with water as it is placed in the well. If there isn't sufficient water in the well to saturate the bentonite, water should be added at a rate of eight gallons per bag.

Bored wells and uncased wells shall be backfilled with clean fill to the water level. If there is freestanding water present in the well prior to the placement of neat cement, the water shall be pumped or bailed or its volume must be figured into the amount of water needed to formulate the neat cement. A two-foot thick bentonite plug shall be placed immediately above the water level. Clean fill shall be placed on top of the bentonite plug and brought up to at least five feet from the ground surface. The top five feet of the well casing, if present, shall be removed from the borehole. If an open annular space is present around the well casing, the annular space shall be filled with grout to the maximum depth possible, but less than or equal to 20 feet. A one foot thick cement or bentonite grout plug that completely fills the bore void space shall be placed a minimum of five feet from the ground surface. The remaining space shall be filled with clean fill which is mounded a minimum of one foot above the surrounding ground surface, being careful to grade the soil so that surface water is directed away from the abandoned well location. Bored wells or uncased wells abandoned in this manner shall be treated as wells with respect to determining the minimum separation distance to sources of contamination. The location of these wells shall be permanently marked for future reference.

The whole length of the well can be sealed with neat cement. Neat cement, if used, shall be inserted in the well through a pipe from the bottom upward in one continuous operation to a point five feet below the ground surface. Topsoil can be used to fill the remainder after cutting off the well casing as described above.

Type II: Wells Constructed in Collapsing Unconsolidated Soil (See Figure 2)

After sanitizing, the well shall be filled completely with a clay slurry or neat cement to a point five feet below the ground surface.

Wells constructed in collapsing material shall be completely filled with grout or bentonite clay slurry by introduction through a pipe initially extending to the bottom of the well. Such pipe shall be raised, but remain submerged in grout, as the well is filled. If there is freestanding water present in the well prior to the placement of neat cement, the water shall be pumped or bailed or its volume must be figured into the amount of water needed to formulate the neat cement.

The well casing shall then be cut off 5 feet below the ground surface. The remainder of the hole shall then be filled with topsoil being careful to grade the soil so that surface water is directed away from the abandoned well location.

Type III: Wells Constructed in Consolidated Rock Formations (See Figure 3)

After sanitizing, the well shall be filled with clean sand or gravel, clay slurry, chipped or pelletized bentonite or neat cement as follows:

Wells constructed in consolidated rock formations or which penetrate zones of consolidated rock may be filled with sand or gravel opposite the zones of consolidated rock. The top of the sand or gravel fill shall be at least five (5) feet below the top of the consolidated rock and at least twenty (20) feet below land surface. The remainder of the well shall be filled with grout, bentonite or clay slurry to within 5 feet of the surface. If bentonite is used, it should be screened to remove dust and fine particles which would tend to clog when being added to the well. The bentonite should be thoroughly saturated with water after each bag is placed in the well. If there isn't sufficient water in the well to saturate the bentonite, water should be added at a rate of eight gallons per bag. Neat cement, if used, shall be inserted in the well through a pipe from the bottom upward in one continuous operation.

If there is freestanding water present in the well prior to the placement of neat cement, the water shall be pumped or bailed out or its volume must be figured into the amount of water needed to formulate the neat cement. Clean compacted clay fill can be continued from 5 feet to the surface, after cutting off the well casing, being careful to grade the soil so that surface water is directed away from the abandoned well location.

ADDITIONAL CRITERIA TO PREVENT COMMINGLING OF GROUNDWATERS BETWEEN SEPARATE WATER-BEARING ZONES

Casing removal is acceptable when the entire casing can be removed from the well. Casings removed from a collapsing formation shall be grouted concurrent with removal such that the bottom of the casing remains submerged in the grout.

CONSIDERATIONS

This practice may be part of a groundwater protection system that includes water and chemical management practices.

To the extent practicable, an abandoned well should be decommissioned in a manner that restores the original hydrogeologic conditions of the well site and does not preclude the use of the site from future land management practices.

Decommissioning requires special consideration of specific geological, biological, physical, and climatic conditions, the chemical composition of the surrounding soil, rock, and groundwater at the well site, and the well's construction practices. All procedures, fill and sealing materials need to be selected according to these considerations.

If cultural resources are noted in the immediate vicinity during construction, work should be stopped and the Natural Resources Conservation Service's State Cultural Resources Coordinator should be contacted.

PLANS AND SPECIFICATIONS

Plans and specifications for decommissioning abandoned water wells shall be consistent with this standard and shall describe the requirements for applying the practice to achieve its intended purposes. They will meet all state and local requirements.

A record of the installation of this practice shall be made and shall include the following information:

- Location of the decommissioned well by latitude/longitude, township/range, or other georeference convention, of such precision that it can be readily located in the field, if required, in the future
- Date of well decommissioning
- Name of landowner
- Total depth of well
- Inside diameter of well bore or casing
- Casing material type or schedule (e.g., standard weight steel, or PVC sch-80)
- Static water level measured from ground surface
- Types of materials used for filling and sealing, quantities used, and depth intervals for emplacement of each type

OPERATION AND MAINTENANCE

The practice site shall be inspected periodically to ensure that the decommissioned well and the adjacent area have not settled or eroded, or are otherwise adversely disturbed. The well site and adjacent ground surfaces shall be maintained in a manner that prevents ponding of surface runoff on the site.

REFERENCES

1. Virginia Private Well Regulations (VR 355-34-100).
2. General Manual Title 450-GM, Part 405; Subpart A, “Compliance with Federal, State, and Local Laws and Regulations”.
3. ASTM D5299, Part 6.3, Plugging Materials.

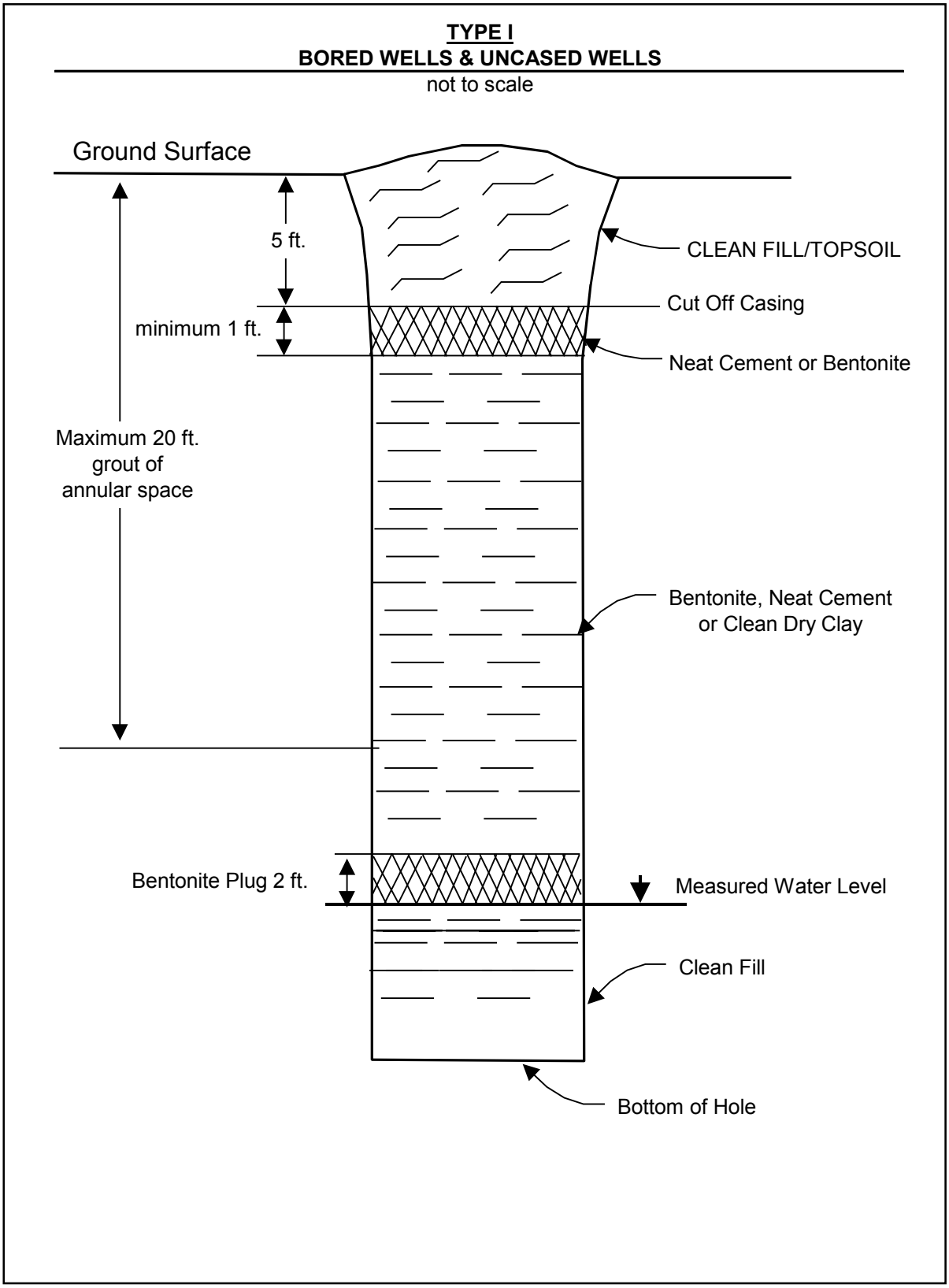

Figure 1. Bored Wells and Uncased Wells

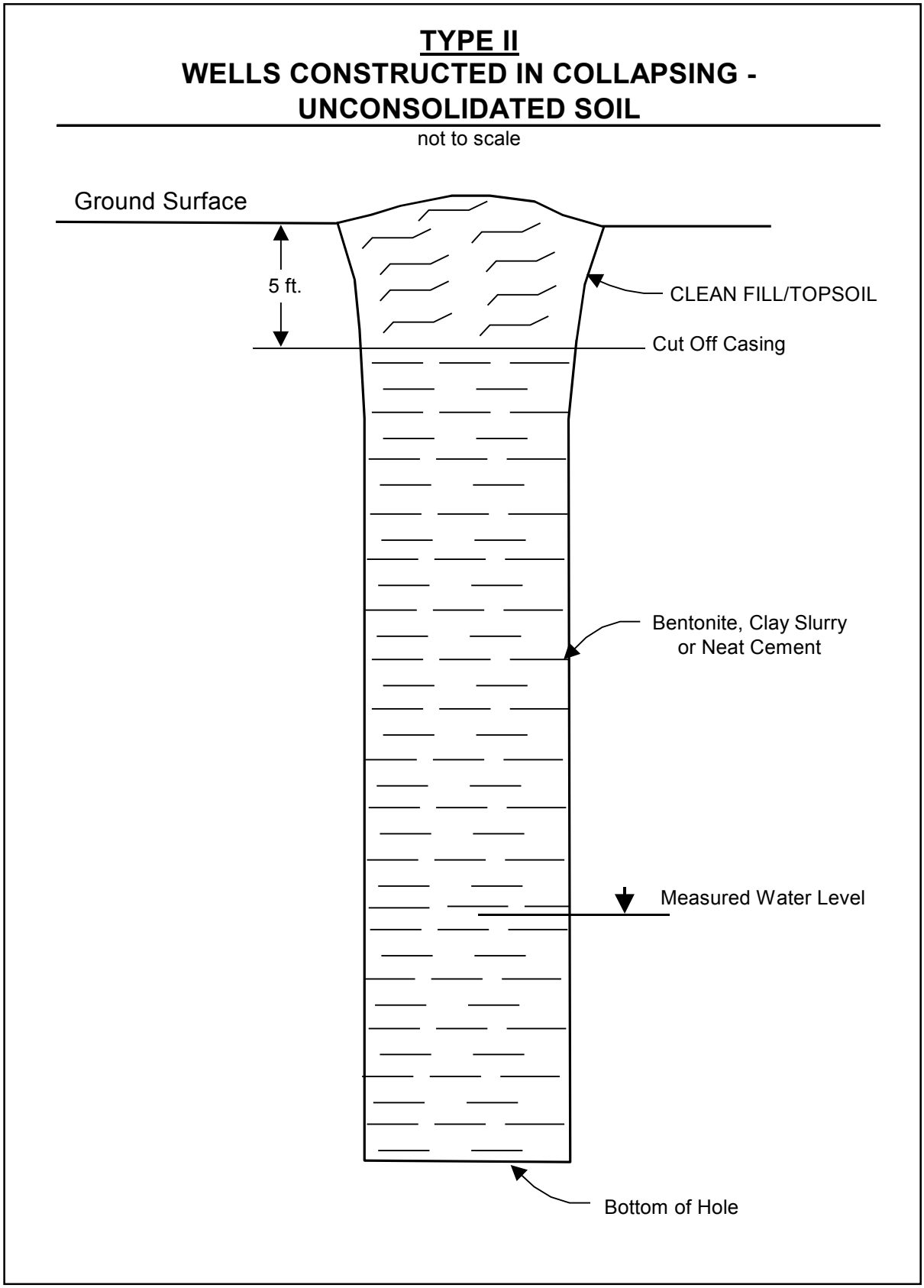

Figure 2. Wells Constructed in Collapsing Unconsolidated Soil

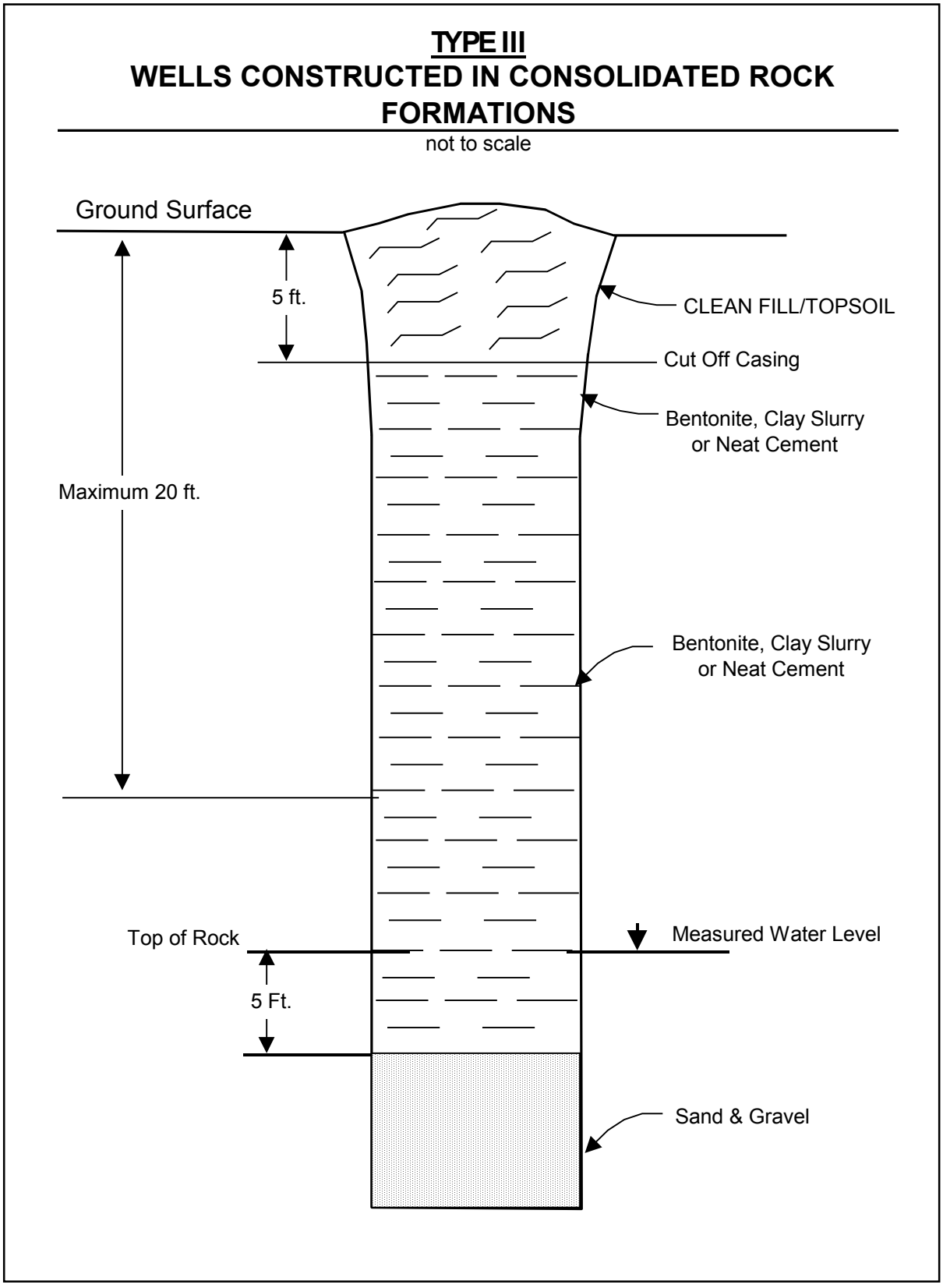

Figure 3 Wells Constructed in Consolidated Rock Formations

NATURAL RESOURCES CONSERVATION SERVICE

VIRGINIA CONSERVATION PRACTICE STANDARD

WELL DECOMMISSIONING

Approved Practice Narrative

(No.)

(CODE 351)

351 D1 Well Decommissioning: The agricultural related well will be sealed and decommissioned at any time of the year so as to prevent contamination of its water and the surrounding groundwater.